

System of Control of Parameters Technical Condition of Machines for Forestry Work

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Summary. It is known that forest machines include various harvesters, forwarders and combinations of them, which is also called combined machines. In this description, these combined machines are also included when harvesters are mentioned, if we consider a function similar to the function in a harvester. It is known that control systems are used to control the forestry machines. One control system of prior art is Jack Matic, which is a system for controlling functions of the forest machine and particularly a harvester head (harvester head) and for measuring and sawing timber. In the forest machine control system controls, among other things, a diesel engine, a transmission unit of the hydrostatic drive of the harvester head and crane system, which is connected with the capture of the harvester, as well as all auxiliary functions associated with them. The control system operates, for example, in the operating environment PC/Windows 2000. In team sawing control system to be treated wood may include, for example, the value distribution and table color paint, group types of wood and types of trunks. Through the included in the in matic 300 application it is possible to analyze and compute the production results, such as number, length and diameter of the logs, levels of distribution, group types of wood and types of trunks.

The control system manages, for example, the capture of the harvester so that the supply control log will automatically adjust the feed rate and pressure of feed rollers and knives and succoring that the protection function of the slippage will prevent slippage of the feed rollers and will give the possibility to stop the tree trunk exactly to cut.

The display device and the CPU of the control system are placed in the cockpit within reach for the driver. Typically, the system also includes a printer.

Control bus in the control and measuring automatics of the control system is based on the known from the prior art technical solution CAN bus (asynchronous serial communication bus) in which data is routed in digital form. In the bus control and measurement signals are transmitted by way of also as such known. Based on the data it is possible to monitor measurements relating to the duration and functional performance of various stages during processing. On the basis of signals and measurements, get information about the functional times and duration for the components responsible for different functions. Components can be, for example, is designed for functions of the crane system or the harvester head connected with her, such as feeding, diameter measurement, length measurement, sawing and cutting branches. Separate treatment of the trunk of a tree includes a large number of measurement values that can be stored in a database that further comprises a classification, for example, on the basis of size classes trunks and logs. Size class

of the trunk is known on the basis of the measurement values.

Key words: technical control, parameter, technical condition, resource, system, machine for forestry work.

INTRODUCTION

The system of measurement of parameters of technical condition of machines for forestry work refers to the measurement of the condition or characteristic values for the performance of one or more subsystems in the machine for forestry work and submission of the result of the operator [1, 2]. Each measurement includes filtering the interfering data to each individual event and data processing (obtaining) reliable characteristic value that can be used in the maintenance and optimization of the parameters of the technical condition of the machine [3, 4].

A group of systems of measurement of parameters of technical condition of machines for forestry work is a means of monitoring the performance of the subsystem of forest machines [5, 6]. The principle of group of inventions is that accumulate data related to a function of said subsystem or to perform the mentioned functions, determine one or more characteristic values to describe the parameters of the technical state of machines are constantly in accordance with the data, and monitor changes over time mentioned one characteristic value or several characteristic values, the time variation of the mentioned one characteristic value or several characteristic values displays the user in form of graphical representation [7, 8].

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

The system of measurement of parameters of technical condition of machines for forestry work relates to a computer program, which relates to a method and to a computer program product [9, 10].

Implementation of systems of measurement of parameters of technical condition of machines for forestry activities in accordance with the options for monitoring are separated:

- current status for the close function of the harvester [11, 12],
- the current state of the supply function of the harvester [13, 14],
- capture device of the harvester [15, 16],
- performance of machines for forestry work [17, 18],
- the fuel consumption of machines for forestry work [19, 20],

- condition (block) transmission hydrostatic drive of machines for forestry work [21]
- function crane systems of machines for forestry work [22].

OBJECTIVE

The purpose of the paper was put to analytically describe the methodological approaches to control system parameters of the technical condition of machines for forestry work.

THE MAIN RESULTS OF THE RESEARCH

In the prior art it is known that machines for forestry work included in the various harvester, forwarders and combinations of them, which is also called combined machines.

In this review, these combined machines also are included when mentioned harvester if we consider a function similar to the function in harvester. It is known that control systems are used to control machines for forestry work.

One control system of the previous prior art is Timberjack Timbermatic 300 (Fig. 1), which, in turn, is a system for controlling machine functions, for timber works and specifically the head of the harvester and for measuring and sawing timber.

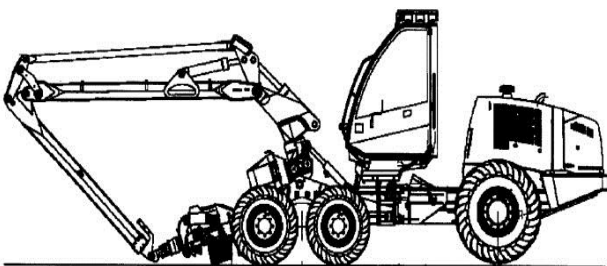


Fig. 1. General view of machines for forestry work

The forestry works management system controls, among others, a diesel engine, a transmission unit of the hydrostatic drive of the harvester head and crane system, which is connected with the capture of the harvester, as well as all auxiliary functions associated with them.

Considered control system works in the operating environment PC/Windows 2010.

The team sawmilling management system to be processed wood, you can include the value, distribution, and color table, group types of wood and types of trunks.

With the help of included in the Timbermatic 300 system application, you can analyze and compute the production results, such as number, length and diameter of the logs, the distribution level, group types of wood and types of trunks (Fig. 2).

The control system controls the capture of the harvester so that the supply control log will automatically adjust the feed rate and the pressure feed rollers and according knives, and a function of preventing slippage will prevent slippage of the feed rollers and to give the possibility to stop the tree trunk exactly to cut (Fig. 3).

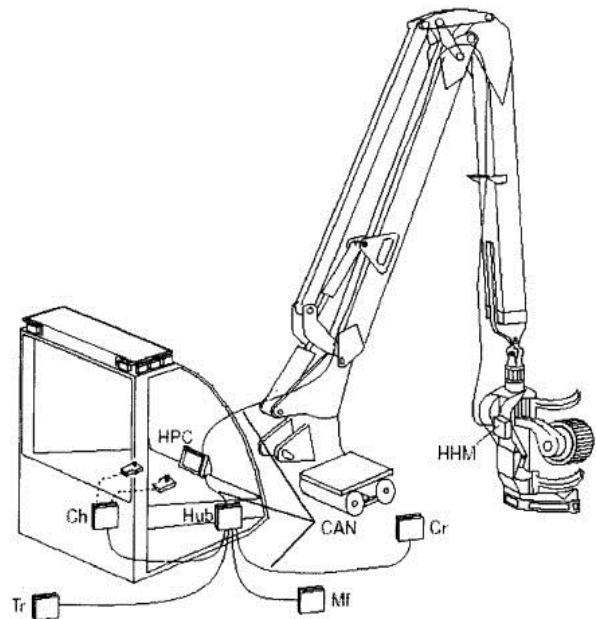


Fig. 2. General view of the control parameters of the technical condition of machines for forestry work

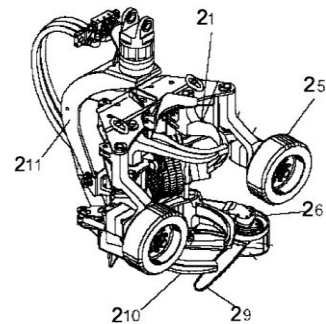


Fig. 3. General view of the control parameters of the technical condition of heads machine for forestry work

The display device and the CPU of the control system are placed in the cockpit within reach for the driver. Typically, the system also includes a printer. Control bus the control and measuring automatics of the control system is based on the known from the prior art technical solution CAN bus (asynchronous serial communication bus) in which data is routed in digital form. In the bus control and measure signals transmitted by a known method. Based on the data is the ability to monitor measurements relating to the duration and functional performance of various stages during processing (Fig. 4). On the basis of signals and measurements, get information about the functional times and duration for the components responsible for different functions. For example, components can be designed for the functions of the crane system or the harvester head connected with it, such as a view, diameter measurement, length measurement, sawing and cutting of knots. Separate treatment of the trunk of a tree includes a large number of measurement values that can be stored in a database that further comprises a classification, for example, on the basis of size classes trunks and logs. Size class of the trunk we know on the basis of the measurement values. Reduced technical characteristics of the forwarder, harvester or harvester capture how the system and its subsystems and components of function will reduce the optimality and efficiency of logging operations (Fig. 5).

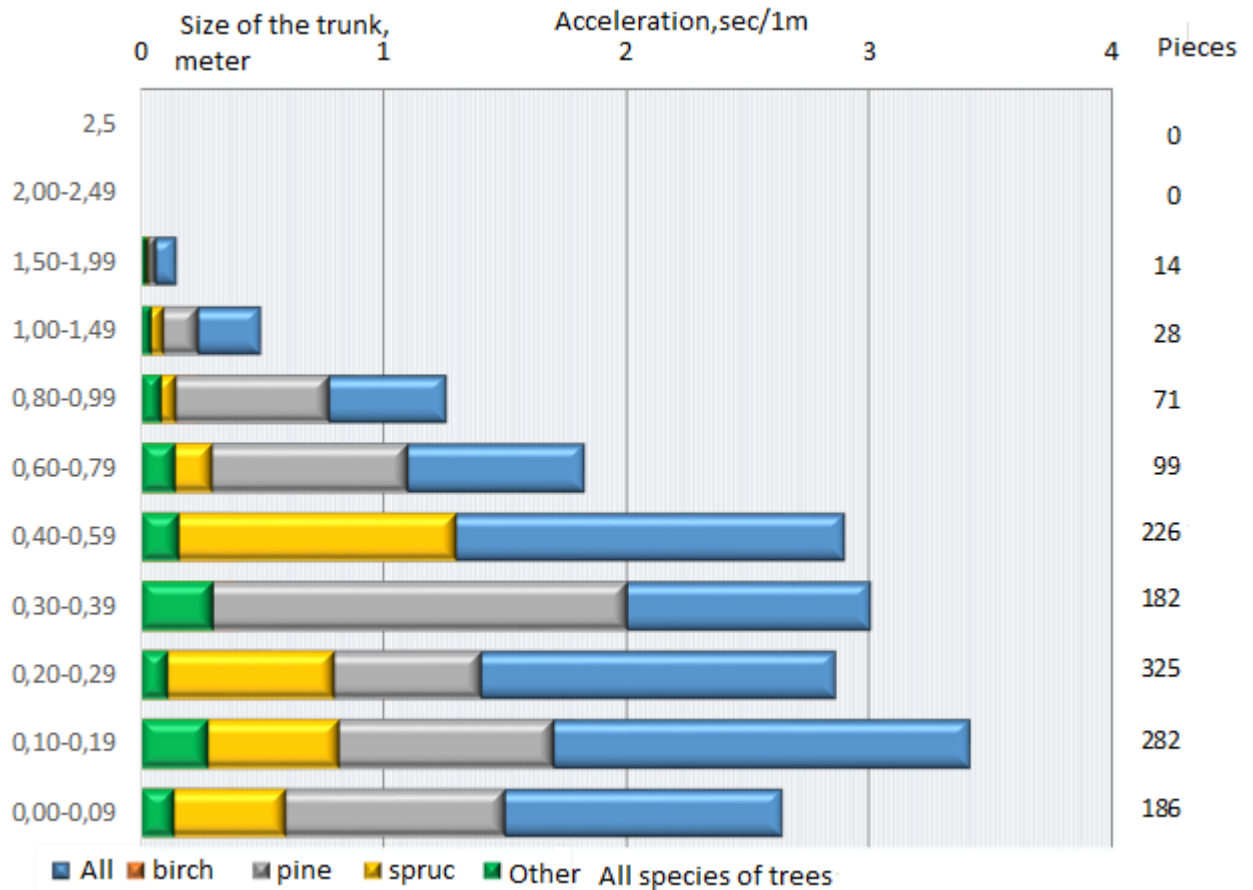


Fig. 4. The dependence of values trunk acceleration and head harvester for the trees

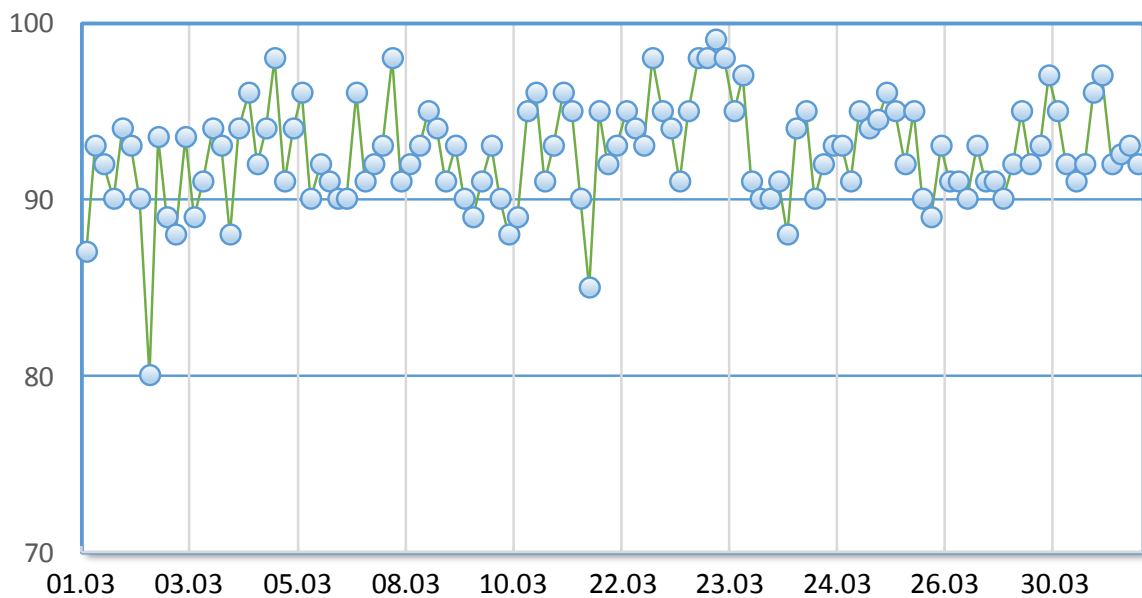


Fig. 5. The index of the harvester head

It was difficult to have a long-term decrease of parameters of technical condition of machines for forestry work as they were based on subjective assessments and experience of the operator or maintenance staff and fitters, which can be time-limited and apply only to certain individual machines for forestry work. In addition, it was impossible in a reliable way to assess the effectiveness of

the repair and replacement of parts, or changes in the ways disability (Fig. 6). For example, earlier it was not possible in a reliable way to monitor the condition of the cutting function or the supply function of the harvester. In the technical solutions of the prior art time periods of spraying are compared with set alarm limits and when the limit is exceeded, the driver displays warning (Fig. 7).

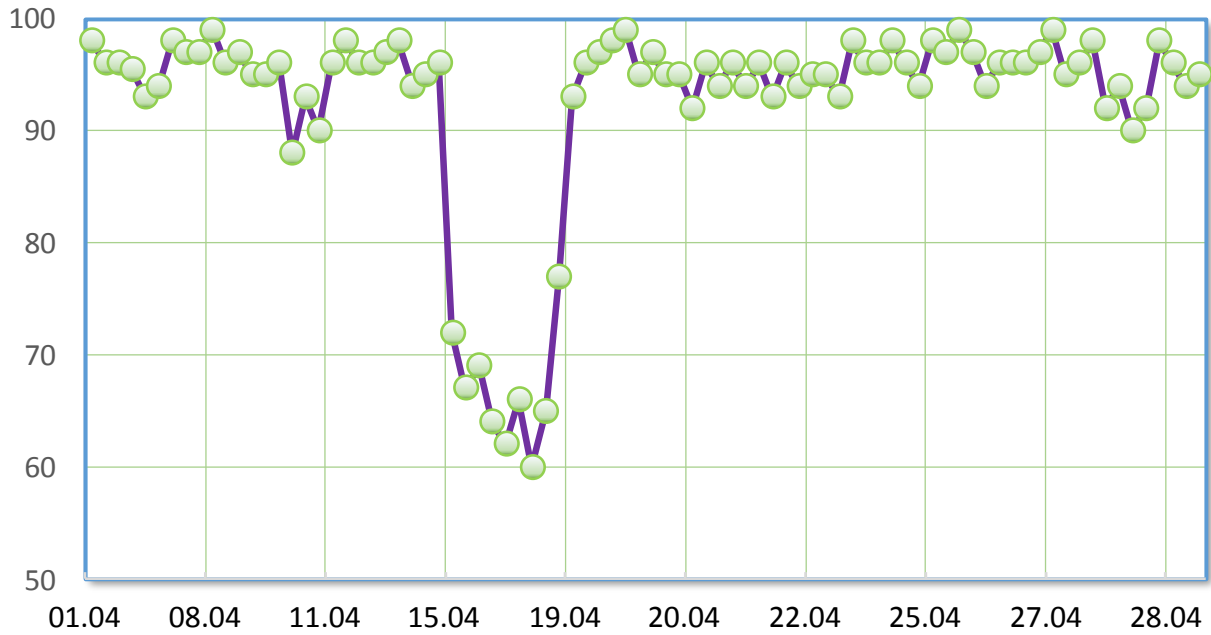


Fig. 6. The index submission of the harvester head

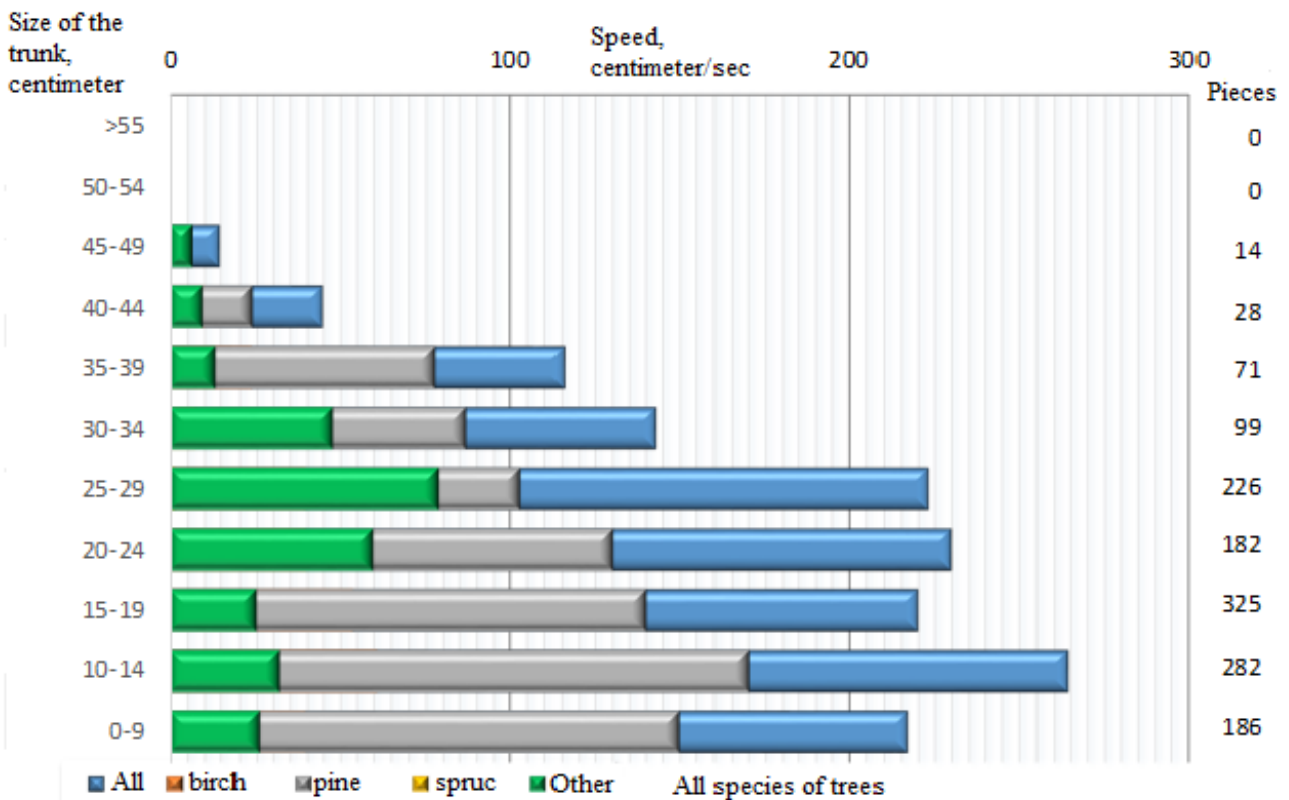


Fig. 7. The dependence of values trunk speed and head harvester for the trees

However, the working characteristics of the spray system or, on the other hand, the supply function is one of the most important factors in the performance of the harvester (Fig. 8).

The reduced performance will reduce the effectiveness of logging and if a long time a failure can lead to further damage, what is worse still, or to stop production.

In addition, previously it was not possible to monitor the state of the contents of the barrel grip harvester.

The contents of the barrel grip harvester is an important factor in the performance and measurement accuracy of the harvester (Fig. 9).

The deterioration in retention of the barrel will reduce the effectiveness of the logging operations.

For example, if the clip soccorsi knives is insufficient, the driving force of the paper feed roller is not effectively transmitted to the barrel and, on the other hand, will be degraded the accuracy of the diameter measurement (Fig. 10).

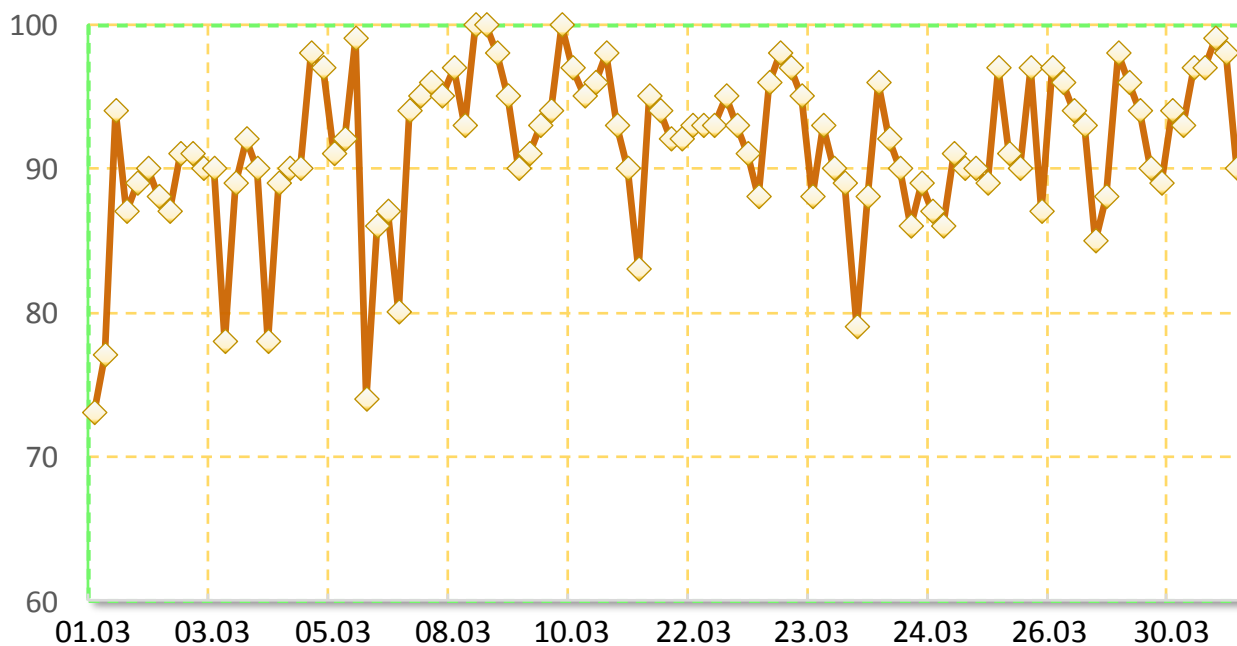


Fig. 8. The index sawing function of the harvester head

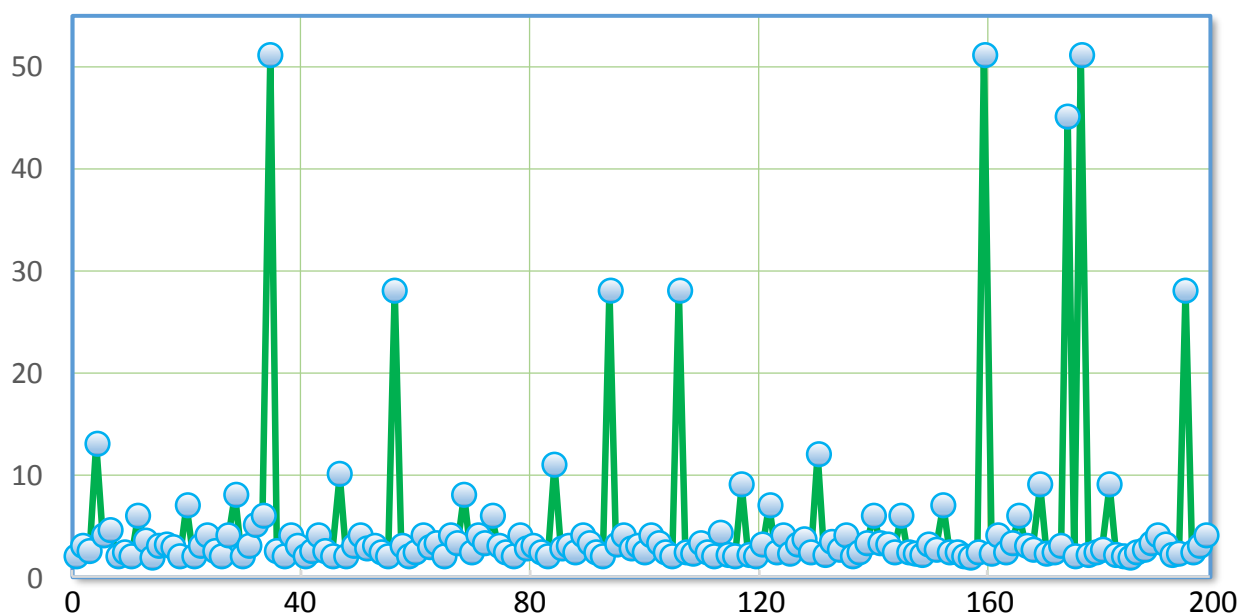


Fig. 9. The index of the harvester head with round wood

The accuracy of the measurement of length will also be degraded because it will increase violation of the contact between the measuring roller and the barrel.

If the clip soccorsi knives is too strong then the force of friction between the blade and the barrel is too big.

Thus, the feed rate and the capture performance will decrease and fuel consumption will increase.

Also it was not possible to measure the performance of machines for forestry work so that the measurement was useful in monitoring the performance and specifically the technical condition of machines for forestry work.

Sufficient productivity of the harvester, that is a large amount of timber processed in cubic meters per hour (m^3/h), is the basic requirement for economic efficiency of mechanized logging.

However, the performance of the harvester may be reduced for a number of reasons such as technical failures or installed machine options that are not suitable for conditions. In addition, previously it was not possible to measure the fuel consumption of machines for forestry work so that the measurement was useful for monitoring the condition of the machine.

Previously measured direct consumption per hour which is not sufficient for evaluation of technical condition of machines for forestry work and for long-term monitoring characteristics. The calculation of characteristic values is usually performed in four steps: measurement, removal of the abnormal dimension values, classification and compensation of measurement data, and calculating characteristic values.

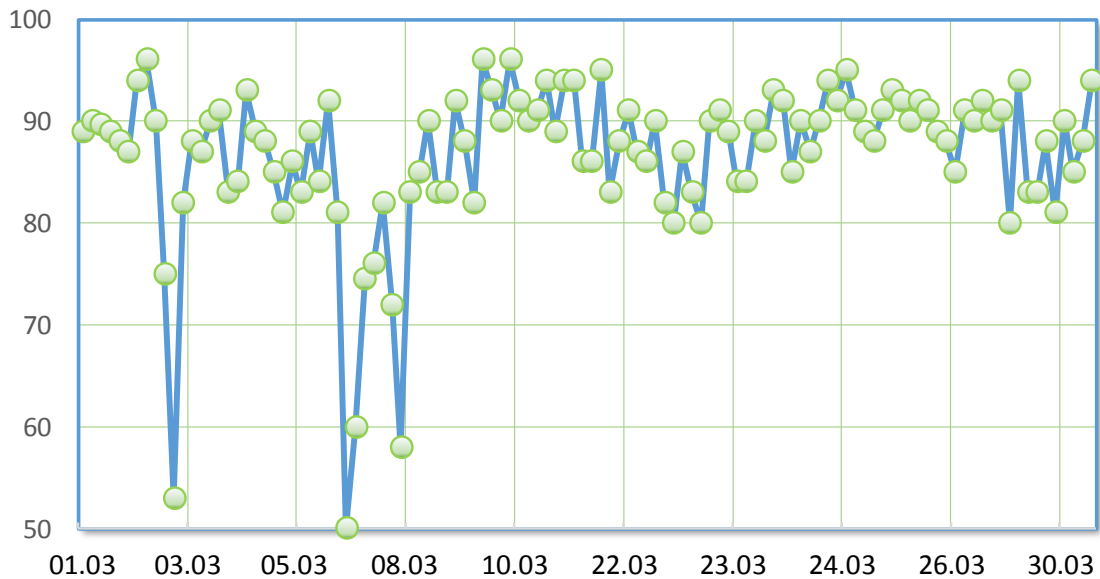


Fig. 10. The index productivity of the harvester head

After the characteristic value was calculated in real time, the result is stored, and the user can observe the dynamic changes of the characteristic values for the desired period of time. Subsystems of machines for forestry work included in the transmission system hydrostatic drive Kranevo system, the sawing function of the harvester, the feeding function of the harvester and the function of holding the barrel of the harvester. The characteristic values of the parameters of the technical condition of machines for forestry work is the performance and fuel economy of the harvester.

Using a system of measurement of parameters of technical condition of machines for forestry work to control the technical characteristics of machines for forestry work, such as forwarders, harvester also allows you to control the grip harvesters and monitoring long-term trend, i.e. the change in time, which may be accomplished by use of measurement values of the indices for various components of the machine functions to forestry operations. Monitoring is carried out by maintaining sufficient historical information or using the display changes graphically or in the form of numerical data, or by obtaining log data for analysis. Using a system of measurement of parameters of technical condition of machines for forestry operations, it is possible to compare data relating to the performance of functions and the data parameters of the technical condition of the machine, measured in different working conditions of machines for forestry work since the parameters to be determined, the index values can be established independent of variable factors, if needed.

The index values can be used to highlight the most important information in a very compact form, in other words, a complete picture of the parameters of the technical condition of the machine can be removed from multidimensional measurement data and a large number of single measurements. The index, which is used as the characteristic value is specified multiple times, and it is determined at timed intervals when some conditions are satisfied or, for example, when a sufficiently large processing quantity or number of logs. The data used in the

system to monitor the status of machines for forestry work, and the illustrative, comprehensive and detailed data provides an excellent basis for expert evaluations as to what the characteristics of these machines for forestry work, which can take place possible problems, and what needs to be done to improve the technical condition.

Specifically, when a measured parameter of the technical condition of machines for forestry work, another particular problem is the dependence of measured values, operating conditions and driving style of the driver. Even these problems can be solved in accordance with the system of measurement of parameters of technical condition of machines for forestry work.

The developed system of measurement and calculation generates a characteristic value indicating the overall technical condition of machines for forestry work, for example, sputtering system or the supply function (sawing index, feeding index). The cutting system consists of a system formed by, diesel engine, drive pump, drive motor saw and chain saw. Changes in the value of the characteristic value that is continuously updated indicate changes in the technical condition of the spray system or supply function.

In addition, the system of measurement of parameters of technical condition of machines for forestry work provides an index used to transfer the state of the actuator as the harvester and forwarder that indicates the relation between the required rotation speed of the hydraulic motor and used speed. The drive transmission system typically contains the hydraulic motor and hydraulic pump operating in a closed system. By monitoring the load distribution are found to be the relative change in the transmission drive and maintenance requirements. Historical information is an important source of information in an unexpected failure events.

In addition, the system of measurement of parameters of technical condition of machines for forestry work provides an index that indicates the parameter of the technical condition of the crane system, describing the function of the crane system or forwarder or harvester.

Thanks to the system of measurement of parameters of technical condition of machines for forestry work can be:

- Proactively identify reduced parameter of the technical condition of the machine. Work parameters can be restored to an acceptable level faster than before, and the average productivity will increase. Repair work can be performed in advance in connection with the usual service, and the resulting increase in utilization will also increase average productivity.

- Proactively detect errors in the contents of the trunk and the causes can be established immediately. The performance can be raised to an acceptable level faster than before, and the average productivity, the average measurement accuracy of the machine will be improved.

- Monitor fuel economy or performance, which can be restored to an acceptable level faster than before, and maintenance costs for the machine will be reduced. Repair work can be performed in advance, and utilization will increase.

In various embodiments of the system of measurement of parameters of technical condition of machines for forestry work includes the steps of calculating in real time, for example, characteristic values of the technical parameters of cutting with a saw or view the characteristic values for the performance of the fuel consumption, the characteristic values for the working characteristics of crane system, the characteristic values for the condition of the drive transmission or the characteristic performance values save characteristic value and display to the operator the prehistory of the parameters of the technical condition of the machine. The measurement, calculation and display of results are performed on a personal computer (PC) related to the control system for forestry machinery.

In various embodiments of the system of measurement of parameters of technical condition of machines for forestry work also include the steps of calculating in real time the characteristic values for retention of the trunk, save characteristic value and display to the operator the prehistory of the working characteristics. The measurement, calculation and display of results are performed in modules that are related to the control system machine.

CONCLUSIONS

1. A particular advantage lies in the fact that the implementation of the various embodiments of the invention does not require the inclusion in the machine of new sensors or computing modules, if it is not necessary. By incorporating the new sensors is also possible to control objects that are not usually included in the monitoring using the control system of the machine for forestry work, but which may be significant for condition monitoring.

2. In one embodiment of the system restore parameters of the technical condition of machines for forestry work calculation according to the invention uses the key dimensions of diameter and length to handle the characteristic value retention of the barrel, which can be used as the basis for maintenance activities and settings the setup acquisition parameters. This is not allowed in any monitoring solution, the relevant prior art.

3. The most important feature of graphical representation of the background characteristic values in accordance with various embodiments of the invention is that it is illustrative for the operator. The background of the index can be graphically represented in various ways.

4. The indexes derived in the different examples of the implementation of the system of measurement of parameters of technical condition of machines for forestry work, can be used to calculate the common index to describe the full operation of the machine for forestry work, for example, using a weighted average. The index values for the various components functions are used to configure optimally the various control parameters of the control system of the forestry machine.

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СИСТЕМА КОНТРОЛЯ ПАРАМЕТРОВ
ТЕХНИЧЕСКОГО СОСТОЯНИЯ
МАШИН ДЛЯ ЛЕСОТЕХНИЧЕСКИХ РАБОТ

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Аннотация. Известно, что лесохозяйственные машины включают в состав различные харвестеры, форвардеры и комбинации из них, которые также называют комбинированными машинами. В данном описании такие комбинированные машины также являются включенными, когда упоминаются харвестеры, если рассматриваемая функция подобна функции в харвестере. Известно, что системы управления используются, чтобы управлять лесохозяйственными машинами. Одной системой управления предшествующего уровня техники является jack matic, которая является системой для управления функциями лесохозяйственной машины и конкретно головкой харвестера (валочной головкой) и для измерения и распиловки лесоматериалов. В лесохозяйственной машине система управления управляет, среди прочего, дизельным двигателем, блоком передачи гидростатического привода, головкой харвестера и крановой системой, с которой соединен захват харвестера, а также всеми вспомогательными функциями, связанными с ними. Рассматриваемая система управления работает, например, в операционной среде PC/Windows 2000. В команды распиловки системы управления для подлежащей обработке древесины возможно включить, например, значение, распределение и таблицы цветовой окраски, группы типов древесины и типы стволов. Посредством включенного в состав в системы matic 300 приложения возможно анализировать и вычислять результаты выработки, такие как количество, длина и диаметр бревен, уровни распределения, группы типов древесины и типы стволов. Система управления управляет, например, захватом харвестера таким образом, что управление подачей бревна будет автоматически подстраивать скорость подачи и давление подающих роликов и сучкорезных ножей и что функция предохранения от проскальзывания будет предотвращать проскальзывание подающих роликов и будет давать возможность останавливать ствол дерева точно для распила. Устройство отображения и центральный процессор системы управления помещаются в кабине в пределах досягаемости для водителя. Обычно система также содержит принтер. Шина управления в контрольно-измерительной автоматике системы управления основывается на известном из уровня техники техническом решении шины CAN (асинхронная последовательная коммуникационная шина), в которой данные пропускаются в цифровой форме. В шине управления измерения и сигналы передаются способом, также как таковым известным. На основе данных является возможным контро-

лизовать измерения, относящиеся к продолжительности и функциональному быстродействию различных этапов в ходе обработки. На основании сигналов и измерений получают информацию о функциональных временах и хронометраже для компонентов, отвечающих за различные функции. Компоненты могут быть, например, предназначены для функций крановой системы или головки харвестера, связанной с ней, таких как подача, измерение диаметра, измерение длины, пиление и резка сучьев. Обработка отдельного ствола дерева включает в состав большое количество значений измерений, которые могут храниться в базе данных, которая дополнительно содержит классификацию, например, на основе размерных классов стволов и бревен. Размерный класс ствола является известным на основе значений измерений.

Ключевые слова: технический контроль, параметр, техническое состояние, ресурс, система, машина для лесотехнических работ.